PSYCHOSOCIAL RISK FACTORS FOR UPPER RESPIRATORY INFECTION:

AN EXPLORATORY STUDY

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SUMMARY

Upper respiratory infections (URIs) generally are mild self-limiting illnesses, but still are a significant source of lost manpower because they occur so frequently. This study attempted to develop a risk profile for URIs as an initial step toward identifying factors which can be manipulated to reduce the risk of URIs and related infectious diseases. The approach was to combine previously identified correlates of URIs which have been studied separately into an overall predictive equation.

The sample was 87 Marine Corps recruits who were healthy at the beginning of basic training. These recruits completed questionnaires measuring past frequency of URIs, past frequency of cold sores, neurotic symptoms, coffee consumption, cigarette smoking, and alcohol consumption. Age and race were determined from Navy records. Health status was measured by symptom reports obtained 2 weeks after beginning training and again 8 weeks later. The criterion variable for the statistical analyses was the number of URIs reported (range 0 to 2). The number of URIs was determined from symptom reports gathered at the end of the second week of training and at the end of training. Correlational analyses assessed associations to individual predictors and multiple regression produced an overall prediction based on the combined predictors.

A higher frequency of URIs during basic training was associated with a past history of frequent URIs, past history of frequent cold sores, and being white. The overall predictive accuracy was moderate (R^2 = .176), but acceptable given the small number of predictors in the equation. A higher frequency of URIs also occurred among those who drank more alcohol prior to entering training, but alcohol consumption was only a marginally significant predictor of URIs after controlling for the three predictors mentioned above. Smoking history and neurotic tendencies showed essentially no relationship to URIs during basic training.

Past history of URIs, past history of cold sores, and race provide an initial risk profile for URIs during basic training. Additional study is needed to determine whether the negative findings for smoking, alcohol consumption, and neuroticism were chance results associated with the specific sample of recruits studied. It should be possible to improve on the initial risk profile by better measurement of URIs and by conducting research to identify risk factors which were not included in this study.

INTRODUCTION

Upper respiratory infections (URIs) are the most common type of infectious disease. Although URIs typically are mild, self-limiting illnesses, their sheer frequency makes them a significant cumulative source of incapacitation due to illness (NCHS, 1986a,1986b; Harlan, et al., 1986). In fact, acute respiratory conditions involve greater costs in terms of lost productivity in the general United States population than conditions such as cardiovascular disease and musculoskeletal problems (Harlan, et al., 1986, p. 12). Frequent URIs also may be a clue to general susceptibility to infectious diseases. A risk profile for URIs therefore could be of value as a means of identifying factors contributing to URIs and other infectious diseases which cumulatively represent a significant source of health-related expenses, particularly in young, generally healthy populations.

For the practical purposes of developing a risk profile for URIs as a tool for further research, the simplest expedient would be to combine previously demonstrated URI correlates into an overall predictive equation. Past frequency of URIs (Jackson, Dowling, Anderson, Riff, Saporta, & Turck, 1960), smoking (e.g., Finklea, Hasselblad, Sandifer, Hammer, & Lowrimore, 1971), alcohol consumption (e.g., Kolb & Gunderson, 1981), depressive symptomatology (Voors, Rytel, Jenkins, Pierce, & Stewart, 1969), and race (Voors, Stewart, Gutekunst, Moldow, & Jenkins, 1968) may be useful indicators of URI risk. The primary study objectives were to replicate prior findings and to provide an initial estimate of the combined predictive power of these URI correlates. The general hypothesis was that past empirical associations would replicate.

METHOD

Sample

Initially, 113 Marine Corps recruits completed the questionnaires employed in this study. However, 26 had URIs when the initial questionnaires were completed. Exploratory analyses showed that including recruits who were ill at the time of initial testing tended to increase some predictor-criterion correlations. One interpretation of this trend would be that concurrent illness affected reports of the predictors. To ensure that analyses involved

predictive rather than concurrent associations, the 26 ill recruits were excluded from the analyses reported below. The remaining recruits did not differ significantly from the excluded recruits on any measure except current health status. The healthy recruits averaged 18.9 (S.D. = 2.10) years of age and 77.4% were White; comparable figures for the ill recruits were 18.9 (S.D. = 1.72) years of age and 80.8% White.

Predictor Measures

Prior to beginning basic training, participants completed a brief questionnaire describing smoking habits and coffee and alcohol consumption. Information on smoking included average number of cigarettes smoked per day, age that the person began smoking, and age when he quit smoking if he had done so. How long the person had smoked was determined by subtracting the individual's age when he began smoking from the age when he quit smoking if he had or from his current age if he had not. Coffee consumption was the estimated number of cups consumed per day. Alcohol intake was the estimated number of drinks per day with a drink defined as one beer, 4 ounces of wine, or a shot of hard liquor.

At the same session, participants completed the Health Opinions Survey (HOS; MacMillan, 1957) extended to include single items about past frequency of colds (Past Colds) and past frequency of cold sores (Past Cold Sores). The HOS is a 20-item questionnaire measuring psychoneurotic symptoms (MacMillan, 1957) with a Likert-scale format with response options "Often" (scored 3), "Sometimes" (scored 2) and "Never" (scored 1). A total score was created (HOS Total) along with scores for psychophysiological and behavioral symptoms of depression (Depressive Symptoms) and anxiety (Anxiety Symptoms) and reports of good health (Well-being). The subscales were identified in factor analyses of data from a large sample of Navy personnel (Butler & Jones, 1979) and were scored in this study because Butler and Jones (1979) found that only depressive symptoms predicted the health outcome of frequency of outpatient treatment. One HOS item dealing with cigarette smoking was treated individually (HOS Smoking) because it had little correlation to any of the factors. Age was determined from Navy records at the time of this initial data collection.

Health Status Measures

Health status during basic training was measured by symptom reports obtained two weeks into basic training and eight weeks later at the end of basic training. A person was classified as having an URI if he had a subjective impression of cold or flu and at least two of the following symptoms: sinus problems, hoarseness, sore throat, cold sweats, productive cough, and chills/fever. This combination of a subjective impression and symptom criterion approximated the widely used procedure developed by Jackson, Dowling, Spiesman, and Boand (1958). Flu was considered in addition to head cold because viral infections frequently cause flu-like symptoms.

The symptoms defining URI were selected from a larger set of symptoms associated with URI on the basis of correlations to the head cold/flu report. This screening was undertaken because some symptoms which otherwise might have been included were not likely to be specific to URIs in basic training. In particular, symptoms such as muscle aches, aching joints and bones, and related problems were more likely to be the result of unusual exercise than URIs in this setting. Symptoms of laryngitis and nonproductive cough were excluded because they overlapped empirically with hoarseness and productive cough, respectively. Excluding these two symptoms ensured that no recruit was classified as ill on the basis of multiple reports of a single symptom.

A "Minor Health Problems" measure was constructed by summing reports of back problems, skin irritation, sunburn, blisters, and athlete's foot. This measure was intended to assess generalized symptom reporting tendency. This composite was regarded as a useful indicator of general symptom reporting tendencies because the constituent health problems obviously did not share a single causative agent.

Analysis Procedures

Pearson product moment correlations tested for relationships between measures. Partial correlations were employed to determine whether significant associations between URI and a predictor could be explained by a second predictor. The combined predictive power of different measures was determined by multiple regression procedures. The estimated regression coefficients obtained with this procedure are unbiased, but the associated significance tests have low statistical power because of inflated estimates of the sampling

variance of the regression weights (Aldrich & Nelson, 1984). However, this inefficiency had to be tolerated because competing procedures require much larger sample sizes to be used effectively. Thus, the statistical estimates should be qualitatively correct but conservative with regard to statistical significance.

RESULTS

URI Frequency

Applying the URI criterion, 75% of the participants had no URIs, 18% had one URI, and 7% had two URIs. Despite this skewed distribution, number of URIs was retained as the primary dependent variable for subsequent analyses because the objective was to predict the number of illness episodes on the assumption that this criterion was the best available indicator of general susceptibility to infection. Exploratory analyses conducted with alternative URI criteria, including a dichotomized infection-no infection variable and the total number of URI symptoms, produced conclusions identical to those obtained with number of URIs.

URI Predictors

Significant URI predictors were: Past Colds, $r = .28$, $p < .004$; Past Cold Sores, $r = .19$, $p < .038$; Race, $r = -.30$, $p < .003$; and alcohol consumption, $r = .22$, $n = 73$, $p < .029$. The association to race indicated that whites had more frequent URIs than non-whites. Coffee consumption ($r = .16$, $n = 59$, $p < .101$) and number of cigarettes per day ($r = .17$, $n = 45$, $p < .124$) were nonsignificant predictors of URI. HOS Depressive Symptoms ($r = -.04$), HOS Anxiety Symptoms ($r = -.05$), HOS Well-being ($r = -.11$), HOS Total ($r = -.11$), and age ($r = .02$) did not approach significance as predictors of URI ($p > .15$ for each).

Predictors of General Symptom Reporting

Minor Health Problems were weakly related to URIs ($r = .16$, $p < .07$) with much stronger associations to HOS scales (HOS Depressive Symptoms, $r = .44$; HOS Anxiety Symptoms, $r = .35$; HOS Total, $r = .47$, $p < .01$ for each).

Multiple Regression of URI Frequency on Significant Predictors

A regression equation was developed with race, past history of colds, and past history of cold sores as predictor variables. The resulting regression equation expressed with unstandardized regression coefficients was:

$$URIs=(.26*\text{Past Colds})+(-.40*\text{Race})+(.21*\text{Past Cold Sores}) + 1.93$$

$$R^2 = .176,\ R^2_{adj} = .145$$

Regression diagnostics (Stevens, 1984) showed no large residuals and no leverage values indicative of influential data points.

A second phase of the multivariate analysis considered the potential predictive value which might derive from adding alcohol consumption, smoking, and coffee consumption to the above prediction equation. These potential predictors were omitted from the regression analysis to avoid the loss of statistical power that would have resulted from the missing data for these variables. Given the small overall sample size, the associated loss of statistical power was unacceptable, particularly in view of the expectation that the true associations between the predictors and the criterion would be modest in magnitude.

To determine how much alcohol, cigarettes, and coffee might have improved the URI prediction had there been more complete data, the predicted number of URIs for each recruit was computed using the above equation. This predicted value was subtracted from the observed number of URIs for each recruit. The resulting difference score was correlated with cigarette, alcohol, and coffee consumption to determine whether an association existed controlling for the predictors in the original equation. The correlations were: Alcohol, $r = .17$, $p < .078$; Cigarettes, $r = .07$, $p < .328$; Coffee, $r = .11$, $p < .212$.

DISCUSSION

This study demonstrated that several previously established correlates of URI had independent explanatory power for predicting URI. Past history of colds and cold sores are likely to be two useful components of a more complex risk profile for infectious disease. Race appears to be an additional component as the present finding that whites had more URIs replicated a previous observation by Voors, et al. (1969). A similar trend has been found in two national surveys (Harlan, et al., 1986; NCHS, 1986b) but not in a third (NCHS, 1986a). Harlan, et al. (1986) suggest that their use of a repeated measures design to assess health status compared with the National Health Interview Survey (NCHS, 1986a,1986b) use of a cross-sectional design may account for this difference. The present study supports this interpretation because it produced findings comparable to Harlan, et al. (1986) using a similar design.

Alcohol consumption may be added to the URI risk profile after further study. This behavior had a significant bivariate correlation to URIs during basic training and explained an additional 2.8% of the variance in URIs controlling for the risk factors mentioned in the preceding paragraph. However, this explanatory power was only marginally significant statistically. Given other evidence that alcohol consumption is related to susceptibility to respiratory infections in military populations (Kolb & Gunderson, 1981), there is a reasonable chance that the marginally significant association will replicate in larger samples and satisfy appropriate criteria for both statistical and substantive significance.

The association between smoking and URIs was not statistically significant in this study. This statement was true whether the analysis compared smokers and non-smokers or related URIs to number of cigarettes smoked per day among the smokers. The number of cigarettes smoked per day did produce a moderate association among the smokers ($r = .17$), but this association was nonsignificant given the small number of smokers. It remains to be seen whether this association will replicate because prior evidence for an association between URIs and smoking has been mixed despite the superficial attractiveness of hypothesizing that smoking would increase the risk of all types of respiratory illness (Finklea, et al., 1971). If the present negative finding replicates, the special circumstances of basic training may explain the modest size of the associations.

It might be argued that past history of smoking does not predict URIs because opportunities to smoke are severely restricted in basic training. This restriction means that past smoking history probably is a poor indicator of the actual amount of smoking during basic training. It is possible that the effects of smoking are not cumulative and cease when smoking stops. If so, frequency of smoking during basic training would be expected to predict URIs but past behavior would not. However, this behavioral restriction hypothesis would seem likely to apply even more strongly to alcohol consumption and alcohol consumption still predicted URIs in basic training. It seems likely, therefore, that both past smoking and past alcohol consumption are weakly related to risk of URIs in basic training with the present results reflecting normal statistical variation in the estimated associations arising from studying a given sample of recruits. Whether this hypothesis is true can only be determined by further research.

The URI findings cannot be attributed to a generalized, neurotic symptom reporting tendency affecting both the predictor and dependent variables. URI frequency during basic training was not related to the HOS scales, a trend which replicates prior findings that neurotic symptomatology is largely independent of infectious disease measured by symptom reports in an unselected population (Totman, Kiff, Reed, & Craig, 1980; Voors, et al., 1969). This independence contrasted with the finding that the HOS scales were related to the Minor Health Problems scale constructed to be a situation-specific measure of neurotic tendencies. Further, the fact that Minor Health Problems were weak predictors of URIs helps to rule out serious contamination of the URI measure by any general symptom reporting tendency specific to basic training.

The conclusion that neuroticism was not related to URI frequency is at odds with studies which suggest that neurotic tendencies are related to susceptibility to infection (e.g., Imboden, Canter, & Cluff, 1958) or general health outcomes which include a significant infectious disease component (Butler & Jones, 1979). The choice of dependent measures may be an important factor in these differences. Studies showing significant associations between health status and neuroticism typically involve measures derived from health records. Such measures reflect differences in health care seeking as well as differences in illness. Thus, one potential explanation of the findings would be that neuroticism is related more to health care seeking than to illness per

se (Kinsman, Dirks, & Jones, 1983). An alternative explanation would be that neurotics are more likely to respond to everyday stresses by engaging in behaviors such as smoking and alcohol consumption or interacting with contagious individuals. Behavioral constraints in basic training would reduce the influence of these mechanisms on the development of URIs and could eliminate differences between neurotics and more stable individuals. These issues should be examined in future research to better define the relationship, if any, between neurotic tendencies and susceptibility to infectious disease.

Speculation regarding possible physiological mechanisms was beyond the scope of this study. Such speculation is not required for the pragmatic purposes of establishing a risk profile and the study provides no direct evidence to support any particular speculation. Beyond this, such speculation would be premature for any of the predictors until it has been established that there are reliable associations to URI independent of other predictors. This condition must be satisfied to ensure that elaborate hypotheses are not constructed on the basis of spurious associations arising from correlations between risk factors. It seems likely that each of the significant correlates of URI described here could be an indirect indicator of a variety of physiological mechanisms. The best approach to identifying these mechanisms would seem to be direct investigation of differences between high and low risk individuals after replicating and extending the present findings to produce a more definitive risk profile.

The overall predictive accuracy obtained in the multiple regressions was moderate, but encouraging given the limitations of the study. URI status was sampled at only two points in time and was measured by only a few symptoms. More frequent assessments sampling a wider range of symptoms could improve prediction by providing more reliable URI assessments (Epstein, 1979). Also, the set of predictor variables can be extended to include additional health history and behavioral variables. Future studies should incorporate these improvements, address the research issues noted above, and determine how the resulting profile relates to other infectious diseases and to immunological variables which might mediate the association between risk and disease.

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Previously reported correlates of upper respiratory infections (URIs) were studied in an initial attempt to develop a risk profile for URIs. The criterion was the number of upper respiratory infections during military basic training. URIs were more frequent among recruits reporting a past history of frequent colds, frequent cold sores, and who were white (R^2 = .176). Alcohol consumption was a significant bivariate predictor of URIs, but did not add significantly to the prediction of URIs controlling for these other factors. Smoking history, age, and neurotic tendencies did not significantly predict URIs in this sample. The results demonstrated the feasibility of a psychosocial risk profile for URIs, but a more satisfactory profile should be possible with improved measurement of URIs and potential predictors such as smoking as well as consideration of other possible risk factors not included in this study. Keywords:

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